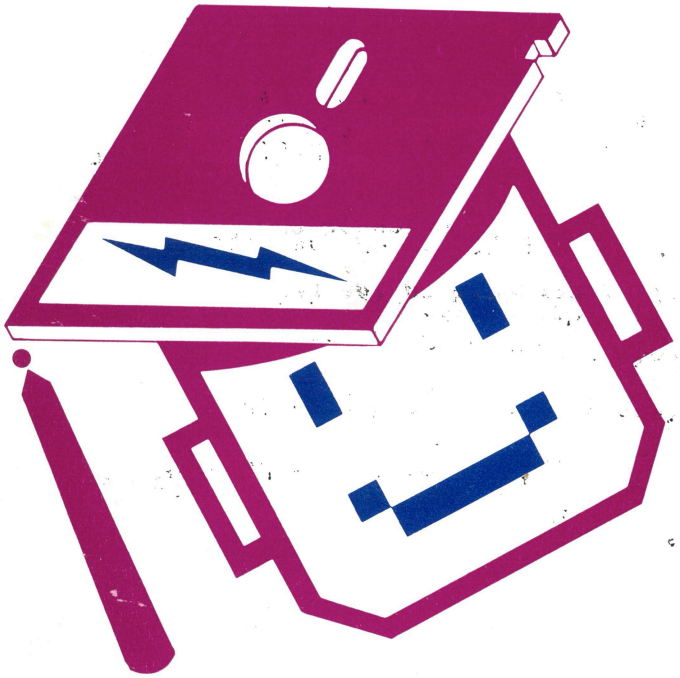
POWER CONTROLLER



ENERGY SCHOLAR SOFTWARE SERIES

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INTRODUCTION

WELCOME TO "POWER CONTROLLER." This simulation puts you and up to two friends in charge of a large power control room for 24 hours (three eight-hour shifts). You will learn about the four different sources of electricity in Wattstown (fossil fuel, nuclear, hydroelectric and pumped storage). You will also learn about the amount of power each source produces and its cost. You must decide which sources to use at different times of the day.

You'll see how the demand for electricity changes at various times during the day and night. If the amount of power you provide isn't enough, you'll cause a brownout or blackout.

When the team completes the three shifts, a chart will appear. It will show:

- the number of blackouts and brownouts (if any), and the penalties for each
- the average power cost to your customers in cents per kilowatt hour

The final screen will report the monthly electricity cost for an average Wattstown family, based on your team effort. Then it will ask if you would like to reduce the cost. You can play again, using what you've learned.

After you've read through the welcome message and general description of game goals, you have a choice: continue the description, or begin to play. If this is your first time playing, you'll want to read the description carefully. It will explain that your job is to provide a continuous flow of power to Wattstown.

Equipment

- Apple IIe, IIc, II + with 64K memory, or an Apple-compatible computer.
- Monitor.
- Disk Drive.

Loading

1. Insert "Power Controller" disk, label side up, into the disk drive. If you have more than one disk drive, use Drive 1.
2. Make sure the disk drive door is closed.
3. Turn on the monitor or T.V.
4. Turn on the computer.

WARNING: DO NOT OPEN THE DISK DRIVE DOOR WHEN THE RED LIGHT IS ON.

Meeting Your Goals

You are the power controller for the Wattstown power facility. Over a 24-hour period, you must meet the demand for electricity in Wattstown. You should find the least expensive way to do this, while still producing enough electricity to keep the town running.

You can buy electricity from four different sources: fossil fuel, nuclear, hydroelectric and pumped storage. Knowing the cost and amount of electricity available from each source will help you decide when to use each one. If you fail to meet the power demand of Wattstown, you will cause a blackout or brownout, and you will be fined.

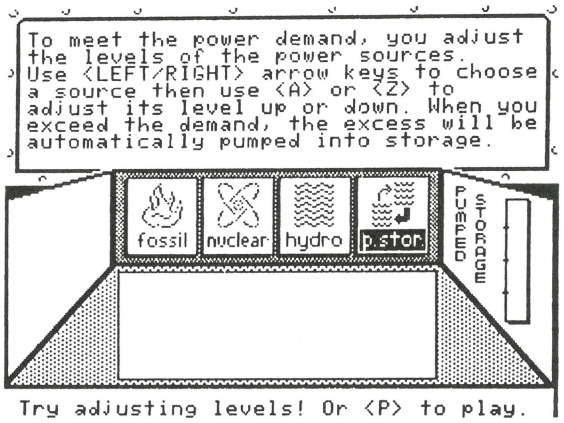
When you see the screen that says "Controller for the Night Shift, type in your first name," enter the first controller's name.* Do the same for the second and third controllers.

If there is only one power controller for all three shifts, press <RETURN> when asked for the names of the second and third controllers. The first controller's name will be entered automatically.

If a name is misspelled, correct it by using the ← key to backspace, then retype.

***Note:** The program will accept a maximum of 27 characters. However, once you exceed 26 characters, you will not be able to correct misspellings.

How To Play


To meet the power demand, you adjust the levels of the power sources. Use <LEFT/RIGHT> arrow keys to choose a source then use <A> or <Z> to adjust its level up or down. When you exceed the demand, the excess will be automatically pumped into storage.
fossil
nuclear
hydro
p.stor
PUMPED STORAGE
Try adjusting levels! Or <P> to play.

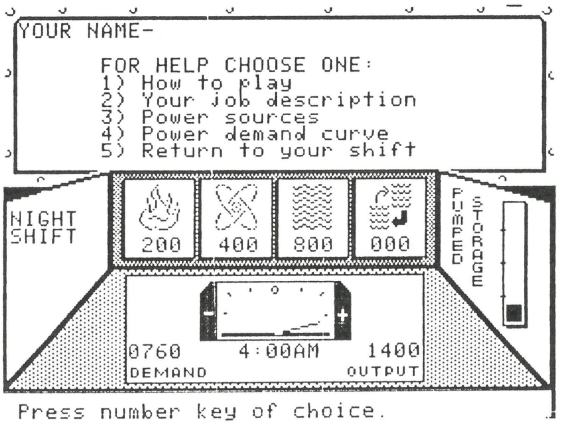
Look at the sample screen above. The four windows show symbols for the four power sources, with the names of the sources below them. Later, the names are replaced by numbers that tell how much power is being supplied by each source.

To find out the maximum for a source, use ← and →keys to choose the source. Each press of the <A> key raises the power supply by 100 MW. Each press of the <Z> key lowers the power supply by 100 MW.

For example, go to the fossil fuel source. Keep pressing the <A> key until you see the word MAX (maximum). That is the most electricity the fossil fuel source can supply.

Now, choose another source and do the same.

At any time during the simulation, you can press the <ESC> key for help. When the help menu appears, press the <1> key, "How to Play," and you will see the screen that appears on the next page.



Look at the meter at the bottom of the screen. Directly under the meter, you see the time of day. To the left of the meter there is a number that tells you how much electricity Wattstown needs at that time. To the right there is a number that tells you how much electricity you are supplying.

The power output (the number on the right) must be equal to, or greater than, the town's power demand (the number on the left). If the output and demand are equal, the needle on the meter will be centered (at zero).

Brownouts And Blackouts

If the output falls 1% to 10% below demand, you will cause a brownout in Wattstown. You will be penalized for each brownout. When you cause a brownout, you must raise the power output to meet the demand level before the time of day changes by 10 minutes, or you will be charged for another brownout.

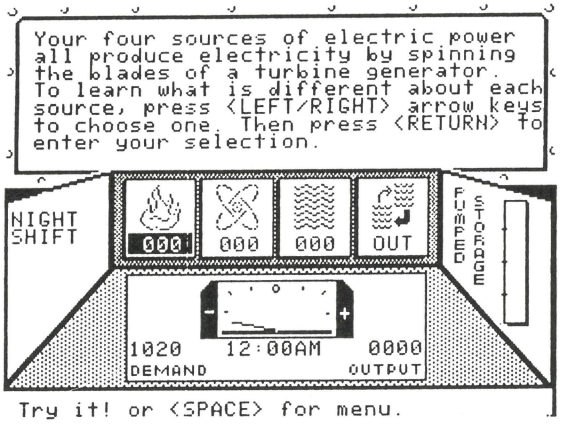
When you are in a brownout, and you want to know what's happened, press the <W> key for "What's a brownout?" All action will stop. You will then have a chance to fix your power levels before the clock starts again.

If the output falls more than 10% below demand, you will cause a blackout in Wattstown. You will be penalized for each blackout. When you cause a blackout, your screen will go dark and all action will stop. Before the clock begins again, you'll have time to raise your output to meet your demand. If your output is less than your demand when you press <SPACE> to start the clock, you will cause another blackout or a brownout.

When you have caused a blackout, press the <W> key for "What's a blackout" to get a definition of a blackout.

In order to avoid brownouts or blackouts, study the demand curve by pressing the <4> key on the menu.

Power Sources


Your four sources of electric power all produce electricity by spinning the blades of a turbine generator. To learn what is different about each source, press <LEFT/RIGHT> arrow keys to choose one. Then press <RETURN> to enter your selection.
NIGHT SHIFT
000
000
000
OUT
PUMPED STORAGE
1020
12:00AM
0000
DEMAND
OUTPUT
Try it! or <SPACE> for menu.

This is very important information. Each power source is described for you, including the maximum amount available from each source in this simulation.

Wattstown uses four sources of electricity: fossil fuel, nuclear, hydroelectric and pumped storage.

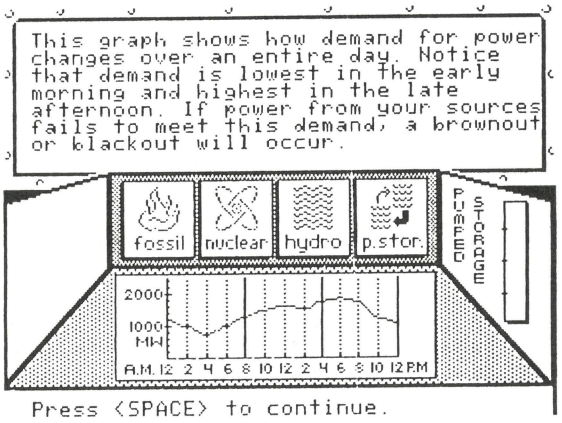
Each power source uses a different form of energy to spin the blades of the turbine-generators. A fossil fuel plant burns oil, gas or coal; a nuclear plant uses the power of the atom; and a hydroelectric plant uses falling water.

Pumped storage is a special kind of power source. It involves using excess electricity from other power sources to pump water from a lower reservoir to a mountaintop (upper) reservoir. Then, during the hours of peak demand, the water is allowed to run back down to create hydroelectric power.

The electricity output of a pumped storage plant depends on the amount of water in the upper reservoir. The amount of electric power is limited by the storage capacity of the upper reservoir.

Find out the maximum output and the cost for each power source by pressing the <3> key, "Power Sources," on the menu.

Demand Curve


This graph shows how demand for power changes over an entire day. Notice that demand is lowest in the early morning and highest in the late afternoon. If power from your sources fails to meet this demand, a brownout or blackout will occur.
fossil
nuclear
hydro
p.stor
PUMPED STORAGE
2000
1000
MW
A.M. 12 2 4 6 8 10 12 2 4 6 8 10 12 P.M.
Press <SPACE> to continue.

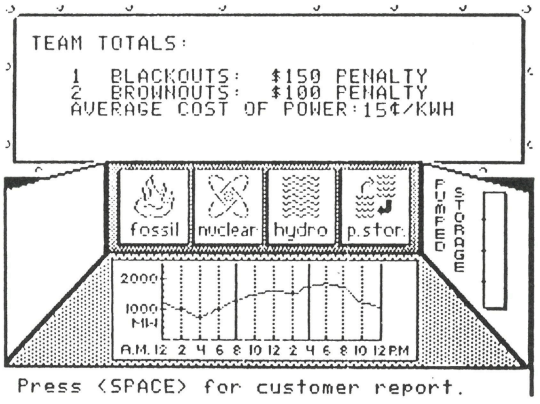
When you read the introduction, you saw a graph called a Demand Curve. It's very important to understand how this relates to the "Power Controller" simulation. Look carefully at the graph. On the left, the megawatts of power are listed. Under the graph are two-hour periods of time. The line that runs through the graph looks like a mountain with two peaks. One high point occurs at noon, and the highest is at 6:00 P.M.

During each shift it is possible to produce more power than Wattstown needs at that time. Whenever your output is larger than your demand, water will be pumped into storage automatically. (Your teacher will explain the efficiency rate of pumped storage.) But remember, the more expensive the fuel you are using to pump, the more expensive your pumped storage energy will be.

Watch the pumped storage symbol carefully and you will see the arrows blink. The left arrow blinks when you are pumping water. The right one blinks when you are using your pumped storage energy. Look to the right of that symbol and you will see the pumped storage gauge begin to rise. Good work! You're storing power that you can then draw upon during peaks in the demand curve when the other three sources cannot produce enough electricity to meet the demand.

TEACHER SECTION

Welcome to "Power Controller." This simulation puts three of your students in control of a large power facility for a 24-hour period (three eight-hour shifts). They will learn about four different sources of electricity (fossil fuel, nuclear, hydroelectric and pumped storage), the amount of power that each produces, and the cost of each one. They must decide which source will give them the most electricity for the least amount of money and which sources to use at different times of the day. They'll see how the demand for electricity changes at various times during the day and night. If the amount of power provided isn't sufficient, a brownout or blackout will occur.



When the simulation ends, a chart will appear. It will show:

- The number of blackouts and brownouts (if any)
- The average power cost to customers in cents per kilowatt hour

The final screen will report the monthly electricity cost for an average Wattstown family, based on the team effort. It will then ask if the team would like to reduce the cost. Students can play again, using what they have learned to provide the necessary power to Wattstown more economically.

Changing the Current Values

```
          CURRENT VALUES

1) SOUND ON
2) COST OF FOSSIL FUEL          15 CENTS/KWH
3) COST OF NUCLEAR POWER        10 CENTS/KWH
4) COST OF HYDROELECTRIC         5 CENTS/KWH
5) COST OF PUMPED STORAGE        5 CENTS/KWH
6) EFFICIENCY OF PUMPED          75 %
        STORAGE
7) CLOCK DELAY FACTOR:1
8) THIS LINE INTENTIONALLY LEFT BLANK
9) PENALTY FOR BLACKOUTS $150
10)PENALTY FOR BROWNOUTS $50


DEPRESS CAPS LOCK KEY


DO YOU WANT TO CHANGE THESE VALUES?
(TYPE Y OR N)
```

If you press the <CONTROL> and <V> keys immediately after you see the first screen with the words "Press <SPACE>," you will get the Current Values menu. You may change any one or all of the values by following the directions you are given on the screen.* The clock delay factor, No.7, controls the speed of the game. The fastest setting is 1; the higher the number you enter, the slower the game.

** You can return to the original values of the game at any time by restoring defaults.*

Pumped Storage

It's particularly important for your students to understand the principles of pumped storage. Around the time when the demand is at its highest point (6:00 P.M.), they must have reserve power in pumped storage to meet the demand. Listed below is the essential information about pumped storage:

1. Water is stored in a specially-constructed upper reservoir.

2. When electricity is needed, water is released and falls to the power plant, where turbines turn generators to make electricity.

3. Water is collected from or discharged into a lower reservoir.

4. Water is pumped back to the upper reservoir (using other sources of electricity) during periods of low-energy demand (e.g. during the night) and stored until needed.

Energy storage devices are less than 100% efficient because electricity must be used to pump the water up to the upper reservoir. Pumped storage power plants are usually not more than 75% efficient. That is, if a plant is operating at 75% efficiency, and you use 100 MW to pump the water, you will get back only 75 MW of electricity.

Note: Be sure to explain the efficiency rate of pumped storage and let your students know what rate you are using for this simulation.

Also, in this simulation, you are charged for the pumped storage while you are pumping, and its cost is based on the cost of the source you are using to pump. Therefore, the cost of pumped storage power, when it is used, should be less expensive than other available power sources.

The New York State Department of Education Block I

These materials were prepared for grades six through nine. They are keyed to the Concepts and Understandings of Block I found in the Science Syllabus for Middle and Junior High Schools of the New York Department of Education. Behavioral objectives are also based on this curriculum. The following describes Block I concepts and behavioral objectives in detail.

For your easy reference, these concepts are listed below exactly as they appear in Block I along with appropriate page numbers.

II. Energy Sources of Past and Present (p. 13)

The history of energy sources and use is presented in short, clear paragraphs. The discussion of the major sources of energy supplements the

brief descriptions in the simulation. Footnote 39 on page 25 gives a particularly good definition of pumped storage.

B. Present major sources of energy

1. fossil fuels (p. 18)
2. hydroelectric power (p. 24)
3. nuclear power (p. 25)
4. electricity as a secondary energy source (p. 28)

III. Aspects of Energy Problems in the U.S. (p. 29)

To understand the need for intelligent use of our energy sources in the United States, we must have a clear picture of both the locations of various types of power used and the implications of each.

A. Patterns of consumption

1. by sector (p. 30)
2. by source (p. 31)
3. implications (pp. 32-33)

IV. Approaches to Energy Problems (p. 40)

An educated citizen knows there are a variety of approaches to any problem. To understand the implications of conservation as one approach to energy problems, this section clearly defines the pros and cons.

A. Conservation (p. 41)

4. advantages and disadvantages of conservation (pp. 45-46)

Appendix A - Learning Activities

In the hands-on activities listed below, a wide variety of experiments and observations can be used to show students different aspects of electrical energy.

I-3 Potential & Kinetic Energy Relationships (p. 68)
I-8 Chemical Energy in a Match (p. 70)
I-24 The Energy Content of Oil (p. 78)
I-28 Heat Content of Major Coal Types (p. 81)
I-31 Energy from Falling Water (p. 83)
I-37 Electricity Production (p. 86)
I-38 Turning a Turbine (p. 86)
I-39 Producing an Electric Current (p. 87)
I-42 Energy: Sources and Uses (p. 89)

Behavioral Objectives

Operating the Simulation. When the students complete the simulation, they will be able to:

- Control the town's electricity supply for each one of three eight-hour shifts. By varying the amount of power drawn from each of the four sources, they will meet demand in the most cost-effective way.
- Meet the town's energy demand without causing brownouts or blackouts.
- Use excess power during low-energy demand periods to create pumped storage capacity. During hours of peak demand, when the total output of the three other plants cannot meet the town's energy demands, students will use their pumped storage power.

Basic Power-Supply Concepts

- Given an electric power demand curve (graph) for a community, students will be able to describe the relationship between demand and time of day.
- Given information on power sources and costs, students will be able to rank each source of electric power in order of increasing cost. (The costs of each source can be changed to reflect the relative cost of each source in the students' community.)
- Given information on the amount of power available from conventional sources (hydroelectric, fossil fuel and nuclear) and the power demand curve (graph), students will demonstrate an understanding of the relationship between pumping water to the upper reservoir during periods of low demand, and using that pumped storage capacity during peak demand times.
- After viewing an animated tutorial on the pumped storage power plant, students will be able to describe each step in the pumped storage process.

Support Materials

Included in your packet are the support materials listed below.

Pre-simulation homework: Students gather data on their own appliances using this home energy survey worksheet to list the wattage of each appliance and the total minutes it is used each day. Using this information, students learn to plot a demand curve of their own home energy use.

Post-simulation assignment: Students can use various mediums to trace the historical development of electrical appliances or explore the idea of living today without electrical power.

Hands-on experiment: Directions for building a generator model.

PRE-SIMULATION HOMEWORK ASSIGNMENT

We take electricity for granted. We don't think about how different our lives would be if we didn't have electricity.

Think about the appliances in your home. Each requires a different amount of electricity to run. You may use some of them once in a while and some of them very often. The appliance use in your friends' homes may be very different from your own.

A list of appliances and the common wattage of each appears below. Every electrical appliance must have a label showing the number of watts it uses.

Look at the first four appliances on the list. If you have these appliances at home, look at each of them when you go home tonight. Find the label that tells the number of watts each uses and write that number on the blank line to the right of each appliance on your list. You may notice differences between your numbers and the numbers given to you.

Common Wattage of Appliances		Wattage of Your Appliances
Hairdryer	1,250 W	_____
Vacuum	650 W	_____
Television	150 W	_____
Toaster	1,150 W	_____
Light	100 W	
Stereo	150 W	
Electric Heat	7,000 W	
Coffee Pot	900 W	
Refrigerator	600 W	
Stove Top	1,200 W	
Oven	6,000 W	
Washer	1,000 W	
Dryer	5,400 W	
Water Heater	4,500 W	

Now look at the chart on the next page. It breaks a 24-hour day into 12 two-hour periods, beginning at midnight. For each two-hour period, find out which appliances from the list are used in your home. Write the name of the

appliance in the first column. In the second column, write the amount of wattage the appliance uses. (Use your own numbers when you have them.) Then, record the approximate number of minutes the appliance is used in the third column.

Ask everyone in your household to help you complete the list. Does someone do the laundry at dinner time? Does anyone use the stove to fix a midnight snack?

Multiply the number of watts each appliance uses by the number of minutes the appliance is on. Put the number on the blank line in the right column marked "Total." For each two-hour period, add up the right column, and put the sum in the box marked "Total for Period."

When you complete the chart, you'll see which times of the day you use the most electricity.

Sample chart

Time Period	Appliances	Wattage	Minutes	Total	Total for Period
6:00 a.m. - 8:00 a.m	Refrigerator	600	11	6,600	
	Hairdryer	1,250	5	6,250	
	Stereo	150	30	4,500	
	Water heater	4,500	15	67,500	
	Stove	1,200	10	12,000	96,850

Take the completed chart with you the next time your class meets. Your teacher will show you how to plot a "demand curve" of your own. You may decide to put all the totals from all the lists together and make a demand curve for your class.

Can you think of some other ways to use this information?

Time Period	Appliances	Wattage	Minutes	Total	Total for Period
Midnight - 2:00 a.m.					
2:00 a.m. - 4:00 a.m.					
4:00 a.m. - 6:00 a.m.					
6:00 a.m. - 8:00 a.m.					
8:00 a.m. - 10:00 a.m.					
10:00 a.m. - Noon					

Time Period	Appliances	Wattage	Minutes	Total	Total for Period
Noon - 2:00 p.m.					
2:00 p.m. - 4:00 p.m.					
4:00 p.m. - 6:00 p.m.					
6:00 p.m. - 8:00 p.m.					
8:00 p.m. - 10:00 p.m.					
10:00 p.m. - Midnight					

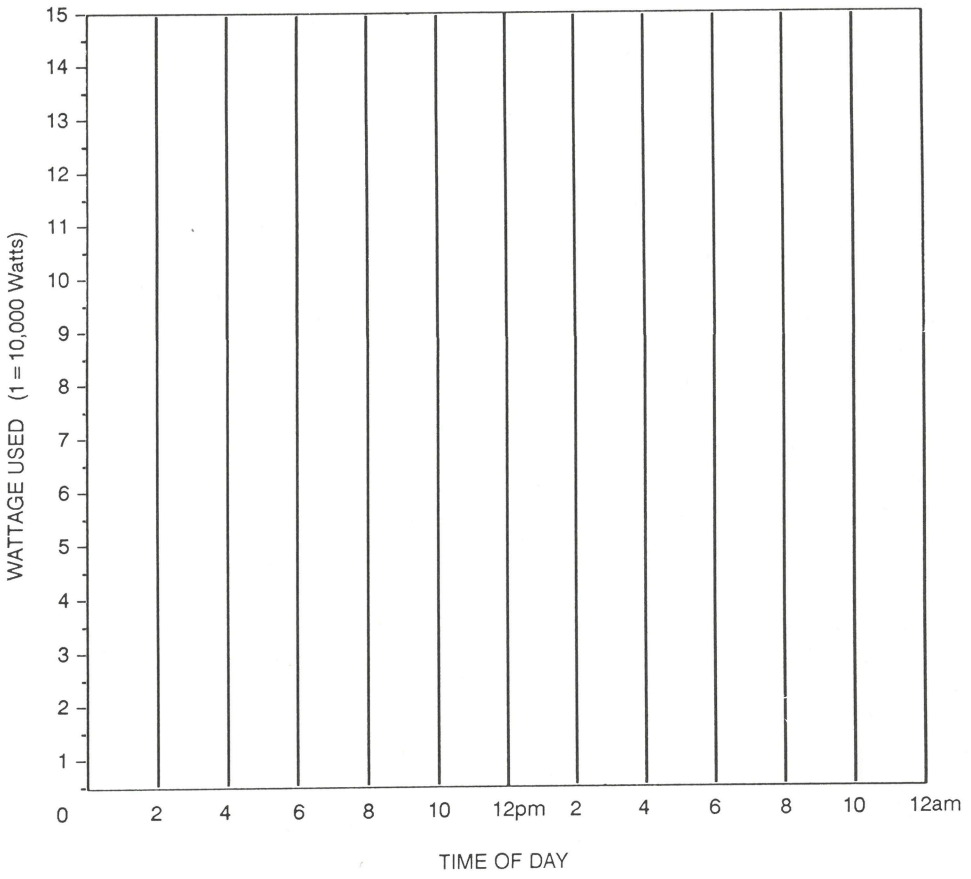
CLASS ASSIGNMENT

The following assignment introduces students to the concept of electrical energy conservation.

Encourage your students to do this assignment with the other members of their household. Awareness of electrical energy use is important for all of us.

When the students bring the completed charts to class, the information can be plotted on copies of the graph below. If you or some of your students are familiar with computer programs that graph information from a data base, make that into another activity to reinforce the concepts.

Construct A Bar Graph By Using Data From Your Chart.



POST-SIMULATION HOMEWORK ASSIGNMENT

Collages of the historical development of electrical appliances

Artistically inclined students may enjoy seeing the changes in design through the years. Or someone may want to photograph old appliances in an antique shop or flea market. If there is a museum that has an exhibit of furnished rooms from earlier decades or centuries, ask students to photograph them and comment about the differences.

Creative writing

Students who enjoy writing may want to create a story about how their lives would be different if electrical power suddenly disappeared.

Add your own ideas to the list and share them with students and colleagues in other disciplines.

BUILDING A GENERATOR MODEL

Objective:
To construct a working model of a generator and detect the current it produces.

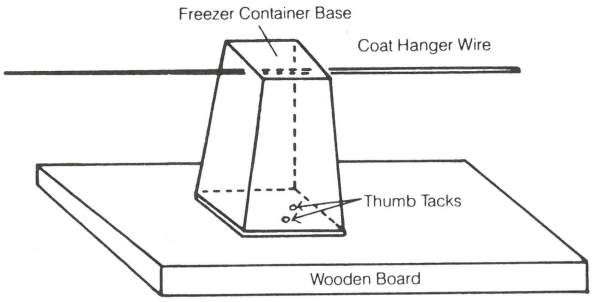
Materials:
- Plastic freezer container and lid (3.5" x 3.5" x 5.5")
- Wooden board (9" x 11" x 0.5")
- 3 thumb tacks
- Wire coat hanger
- Masking tape
- Scotch tape
- Bar magnet (4" long)
- Paper clip
- Plastic curler with clip (1" to 1.25" in diameter)
- #30 gauge enameled-copper wire
- Matches
- Galvanometer (directions for this follow)

Tools:
- Pliers
- Wire cutter
- Awl

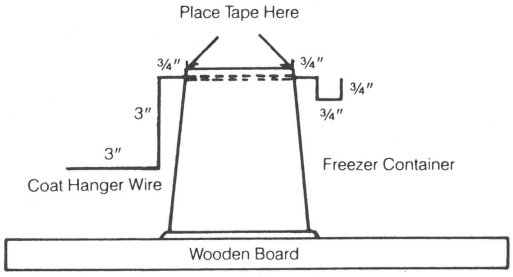
Directions:
Step 1 - Position the lid from the plastic freezer container up-side-down on the wooden board. Secure the lid to the board by pushing three thumb tacks through the lid and into the board.

Step 2 - Snap the freezer container into its lid. Use the awl to punch a hole in the middle of one side of the container near its original base. Punch a second hole in the container, opposite the first.

Step 3 - Snip a long straight piece from the wire coat hanger with the wire cutter. Slide the wire through the holes in the freezer container.



Step 4 - Bend the wire into the desired shape with pliers. Use the diagram below as a guide. Secure this axle by wrapping a 5" piece of masking tape around each 3/4" length of wire protruding from the container. The axle should turn freely, but not slide back and forth through the holes.

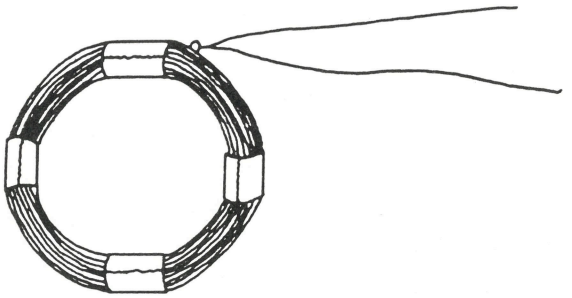


Step 5 - Prepare the magnet. To do this, first, cut one end from a paper clip. Then, tape it to one end of the bar magnet to form a loop. Hang the magnet on the small hook formed from the coat hanger.

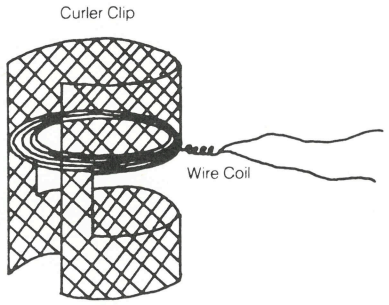
Step 6 - Wrap the enameled-copper wire 100 times around the plastic curler. Start 12" from one end of the wire; this forms the first lead. When you finish there should be about 12" of wire remaining for the second lead.

Step 7 - Twist the two wires together close to the curler so the coil will not unravel. Carefully melt off several inches of insulation from the two leads with a lit match.

Step 8 - Slide the wire coil off the curler and wrap scotch tape around the coil in four places, equal distances apart as shown in the diagram below.

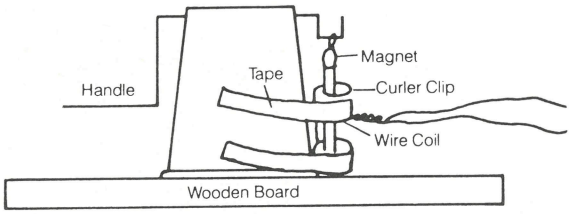


Step 9 - Fit the wire coil into the plastic curler clip so the coil is held in a horizontal position when the curler clip sits on end. Place the curler clip underneath the magnet so the magnet hangs inside the coil. Tape the curler clip in position next to the plastic freezer container.



Step 10 -To operate the generator, turn the handle so that it makes one complete turn in about two seconds. The magnet will rise and fall inside the wire coil. The generator produces alternating current.

To test the production of electrical current, construct a galvanometer (instructions follow) and connect it to the leads from the wire coil. Watch what happens!



CONSTRUCTING A GALVANOMETER

Objective:
To construct a device that will detect electrical current.

Materials:
- #30 gauge enameled-copper wire
- Masking tape
- Scotch tape
- Sewing needle
- Fine sewing thread
- "D" cell battery
- Matches

Directions:
Step 1 - Wrap the enameled-copper wire 100 times around the "D" cell battery. Start 12" from one end of the wire; this forms the first lead. When you finish there should be about 12" of wire remaining for the second lead.

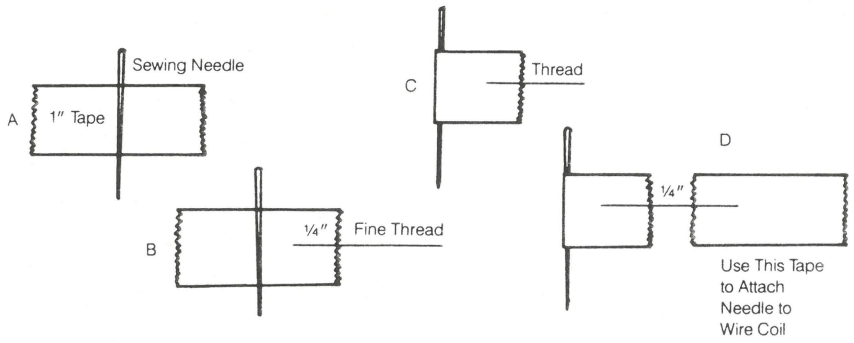
Step 2 - Twist the two wires together near the battery so the coil will not unravel. Carefully melt off several inches of insulation from the two leads with a lit match.

Step 3 - Slide the wire coil off the battery and wrap tape around the coil in four places, equal distances apart.

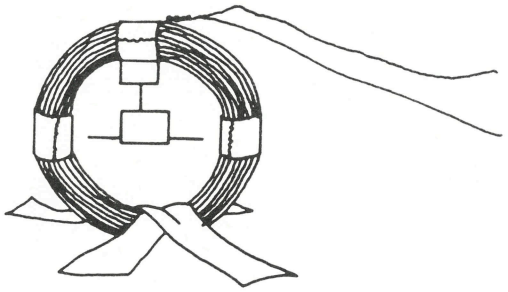
Step 4 - Tape the coil to the table top with masking tape so that the free ends of the wire are at the top of the coil.

Step 5 - Cut a piece of scotch tape 1" long. Place the sewing needle lengthwise across the middle of the sticky side of the tape. Cut a 1" length of very fine thread. Place the thread on the sticky side of the tape, so that 1/4" to 1/2" of the thread is lying on the tape. Now, fold the tape so that the ends of the tape are together. Cut another piece

of scotch tape 1" long. Stick the 1" piece of tape to the thread so that there is 1/4" between the two pieces of scotch tape.



Step 6 - Magnetize the needle by stroking it with a magnet. Then, use the scotch tape to suspend the needle from the top of the coil, so that the needle hangs halfway down from the inside top of the coil. The galvanometer coil should be aligned in a north-south direction so the needle points in the same direction as the plane of the coil.



Step 7 - Test the generator. To do this, wrap the galvanometer leads and the generator coil leads together. Tape the galvanometer to the table top about one foot from the generator. As you turn the generator handle, watch the galvanometer needle. It should rotate inside the wire coil. This indicates that there is a magnetic field present due to an electric current in the wire.

Teacher References

Boltz, C.L. (1985). **How Electricity is Made.** Facts on File Publications: New York/Bichester, England.

If you have time for only one book, this is the one. The descriptions of the types of energy and an excellent description of a power control station are only a few of its outstanding features. A kind of flow chart traces energy production from its ultimate source (the sun), through natural processors to four types of energy, then through commercial processing to the principal users. A chronology of important dates in the history of electricity, a comparison of electrical power use between England and the USA, a glossary and an index complete this reference. This book was originally published in England and often refers to British or European examples -- a nice touch if you'd like to broaden your outlook.

Boyle, Desmond. (1980). **Visual Science: Energy.** Silver Burdett Company.

This clear, concise collection consists of two-page essays with color photographs, diagrams, a glossary of terms, a list of references and an index. The early essays describe energy sources, while later ones discuss energy-related issues such as conservation and pollution.

Douglas, John H., and the Editors of Grolier. (1984). **The Future World of Energy.** Grolier.

This is an Epcot Center – Walt Disney World book. It's good on the history and description of energy sources, but the accent is on plans for the future. Magnificent color pictures of space stations and futuristic buildings, in addition to excellent traditional photographs, make this a reference you'll enjoy looking at as well as learning from. Glossary and index included.

Student References

Carey, Helen H. (1984). **Producing Energy.** Franklin Watts: New York/London/Toronto/Sydney.

(pp. 1-45) If you want to understand the production of energy at its most basic level, this is your source. You'll find out how people mine coal and drill for oil and natural gas. Also, the nuclear energy process is examined from finding uranium to running a nuclear power plant. Glossary and index included.

Satchwell, John. (1985). **Energy Today: Water.** Gloucester Press: New York/Toronto.

(pp. 10-17) The full-color photographs and models with simple text make this an ideal resource if you want a lot of information on hydroelectric power in a condensed version.

Vogt, Gregory. (1985). **Electricity and Magnetism.** Franklin Watts: New York/London/Toronto/Sydney.

(Chap. 4, pp. 35-51) Making Electricity: history of static electricity, batteries, generators and their relationship to electricity production. The emphasis here is on classic historical experiments, and the old pictures that illustrate the chapter are delightful.

(Chap. 6, pp. 59-72) Using Electricity: discusses three specific uses – powering electric motors to produce motion, producing heat and light, and carrying information. Good illustrations.

Vogt, Gregory. (1986). **Generating Electricity**. Franklin Watts: New York/London/Toronto/Sydney.

(pp. 14-26) There's a lot of material on magnetic generators here, plus clear and illustrated directions for making an electric swing. This simple experiment demonstrates the action of a magnetic generator and an electric motor. The sections on fossil fuels and nuclear fuels each have an excellent diagram to help you understand how these sources are used to produce electricity.

GLOSSARY

Blackout: Total loss of electric power to a house or a neighborhood.

Brownout: When electricity supplies cannot meet demand and a utility reduces the voltage of electric power. Appliances will continue to operate, but some at reduced efficiency. Lights may dim.

Fossil Fuel: Coal, oil or natural gas. In a fossil fuel electric power plant, coal, oil or natural gas is burned to turn water into steam. The steam spins a turbine-generator to produce electricity.

Hydroelectric Energy (hydropower): Electricity created by the force of falling water. In a hydroelectric plant, falling water spins a turbine-generator to produce electricity.

Kilowatt (KW): 1,000 watts. Since a watt is a very small unit, "kilowatt" is usually used to figure out a household's electricity use.

Kilowatt Hour (KWH): One kilowatt of electricity for one hour. For example, the use of ten 100-watt light bulbs for one hour will consume one kilowatt hour of electricity (1,000 watts, or one kilowatt, for one hour).

Megawatt (MW): 1,000,000 watts or 1,000 kilowatts.

Megawatt Hour(MWH): One megawatt of electricity for one hour.

Nuclear Energy: Energy created by splitting uranium atoms. In a nuclear plant, uranium atoms are split, creating heat that boils water. The boiling water creates steam, which spins a turbine-generator to produce electricity.

Pumped Storage: A method of storing water to create electricity at a later time. In a pumped storage plant, water is pumped to an upper reservoir at times when the energy demand is low. Later, when energy demand increases, the water is released from the upper reservoir. The falling water spins the blades of the turbine-generator to produce electricity.

Turbine-Generator: A device with fan-like blades, a turbine, is connected to an electrical generator to produce electricity. Steam or falling water rotates the blades of the turbine. The spinning turbine causes magnets in the generator to rotate past copper bars, producing electric current.

Watt: The basic unit used to measure electrical power.